

--	--	--	--	--	--	--	--	--	--

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/23 (TERM ID 2220)

EMT1016 – ENGINEERING MATHEMATICS 1

12 JULY 2023

9:00 AM – 11:00 AM

(2 hours)

INSTRUCTIONS TO STUDENTS:

1. This exam paper consists of **6 pages** (including cover page) with **4 Questions** only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of marks for each question is given.
3. Please write your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.
4. Only **NON-PROGRAMMABLE** calculator is allowed.
5. Some useful formulae and tables are provided in the **Appendix** for your reference.

Question 1

- (a) Find the $\frac{dy}{dx}$ if $x^2y + \sin(x) + y^3 = 20$. [5 marks]

- (b) Evaluate $\int \frac{2x-1}{(x-3)(2-x)} dx$. [6 marks]

- (c) Find the area of the region bounded by the curves $y = x^2 - 2$ and $y = x + 4$. [7 marks]

- (d) Consider the function

$$f(x) = \begin{cases} x+a & x > 1, \\ 4 & x = 1, \\ x^2+b & x < 1, \end{cases}$$

with a and b are constants. Find the value of a and b such that $f(x)$ is continuous at $x = 1$. [7 marks]

Question 2

- (a) Find the radius of convergence and the interval of convergence for $\sum_{n=1}^{\infty} \frac{3^n}{n!} (x+4)^n$. [6 marks]

- (b) Given that $e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!}$ for all x , evaluate xe^{-2x} as a Maclaurin series. [4 marks]

- (c) Consider the complex number $z = -1 + \sqrt{3}i$.

(i) Find the modulus and principal argument of z . [4 marks]

(ii) Express e^z and $\text{Ln}(z)$ in Cartesian form. [6 marks]

(iii) Find all the three roots of $z^{\frac{1}{3}}$. [5 marks]

Continued...

Question 3

- (a) Find a half-range Fourier sine series for $f(x)$ defined in the interval $-\pi \leq x < \pi$

$$f(x) = x^2, \quad -\pi \leq x < \pi, \text{ and } f(x+2\pi) = f(x).$$

[12 marks]

- (b) A function $f(x)$ is defined over the interval $0 \leq x < 2$ by

$$f(x) = \begin{cases} x & 0 \leq x < 1 \\ 1 & 1 \leq x < 2 \end{cases}.$$

Suppose $f(x)$ is an **even** periodic function with **period 4**.

- (i) Sketch the graph of $f(x)$ from $x = -8$ to $x = 8$. [6 marks]
- (ii) To what value will the trigonometric Fourier series of $f(x)$ converge at $x = 4$, and $x = -0.5$? [3 marks]
- (iii) If $g(x)$ is an odd function with period 2, what would be the period of $g(x) \times f(x)$? Would $g(x) \times h(x)$ be odd, even or neither? [4 marks]

Continued...

Question 4

(Note: you may use the tables in APPENDIX A and APPENDIX B in solving Question 4.)

- (a) The distribution of the daily number of malfunctioning units produced in a manufacturing line is given as follows:

Number of malfunctioning units	0	1	2	3	4	5	6	7
Probability	0.07	a	0.29	$2a$	$2a$	0.06	0.02	0.01

- (i) Show that $a = 0.11$. [3 marks]
- (ii) Find the average daily number of malfunctioning units produced. [4 marks]
- (iii) If the malfunctioning units are five or more, the manufacturer will suffer a loss. How likely is it that the manufacturer won't lose? [4 marks]
- (b) Given that on average 2 passengers on the flight will order vegetarian meals.
- (i) Find the probability that on a particular flight, 3 or more passengers will order vegetarian meals. [4 marks]
- (ii) If there are 3 flights scheduled in one day, find the probability that nobody will order vegetarian meal on that day. [5 marks]
- (c) The diameters of ball bearings produced by a particular machine follow a normal distribution with mean 5.00mm and standard deviation 0.01 mm. The ball bearing is acceptable for packing if its diameter falls between 4.98mm and 5.01mm. Find the probability that a ball bearing will be rejected during packing. [5 marks]

Continued...

APPENDIX A: Special Probability Distributions

Binomial Distribution, $X \sim b(x, n, p)$

$P(X = x) = {}^nC_x p^x q^{n-x}$, for $x = 0, 1, \dots, n$ and where $q = 1 - p$.

$$E[X] = np; \text{Var}(X) = npq$$

Poisson Distribution, $X \sim p(x, \lambda)$

$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$, for $x = 0, 1, \dots$

$$E[X] = \lambda; \text{Var}(X) = \lambda$$

Continuous Uniform Distribution, $X \sim U(a, b)$

$$f_X(x) = \begin{cases} \frac{1}{b-a}, & a < x < b \\ 0, & \text{elsewhere} \end{cases}$$

$$E[X] = \frac{a+b}{2}; \text{Var}(X) = \frac{(b-a)^2}{12}$$

Exponential Distribution, $X \sim \exp(1/\beta)$

$$f_X(x) = \begin{cases} \frac{1}{\beta} e^{-x/\beta}, & x > 0 \\ 0, & \text{elsewhere} \end{cases}$$

$$E[X] = \beta; \text{Var}(X) = \beta^2$$

Normal Distribution, $X \sim N(\mu, \sigma)$

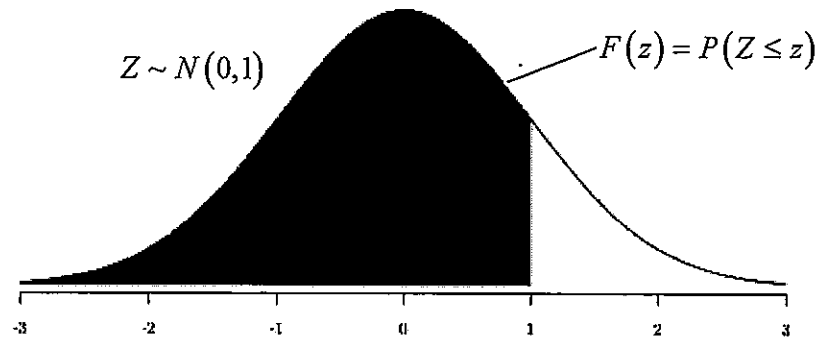
If X is any normal random variable where $X \sim N(\mu, \sigma)$, then the transformation

$$Z = \frac{X - \mu}{\sigma}$$

yields a *standard* normal variable where $Z \sim N(0, 1)$.

Continued...

APPENDIX B: Cumulative Standard Normal Distribution



	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

End of Paper.